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(54) Detecting frequency correction burst

(57) Block 1 receives I-channel data modulated using continuous PSK and multiplies it by a sine signal which has a frequency given by the frequency correction burst to give a first channel signal while block 2 does the same for the Q-channel to give a second channel signal signal. The channel signals pass through a low pass filter 4 to first energy estimation block 5 while the channel signals pass directly to to second energy estimation block 6. Block 7 normalises their outputs and burst discriminator 8 detects the frequency correction burst.

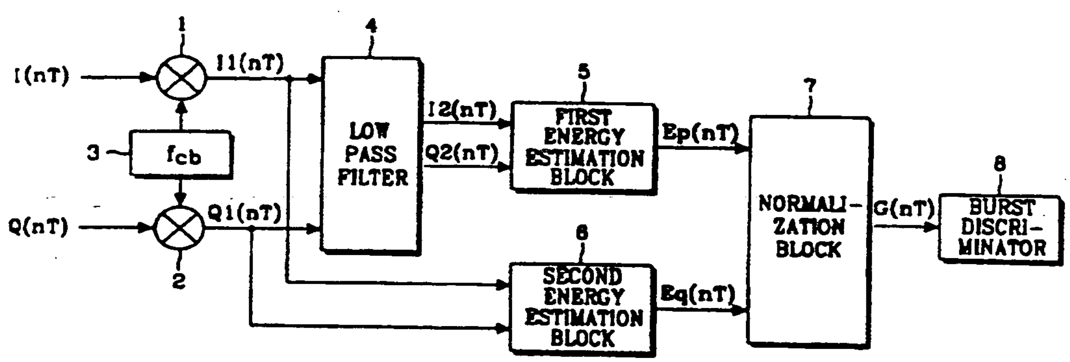


FIG. 2

GB 2 316 840 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

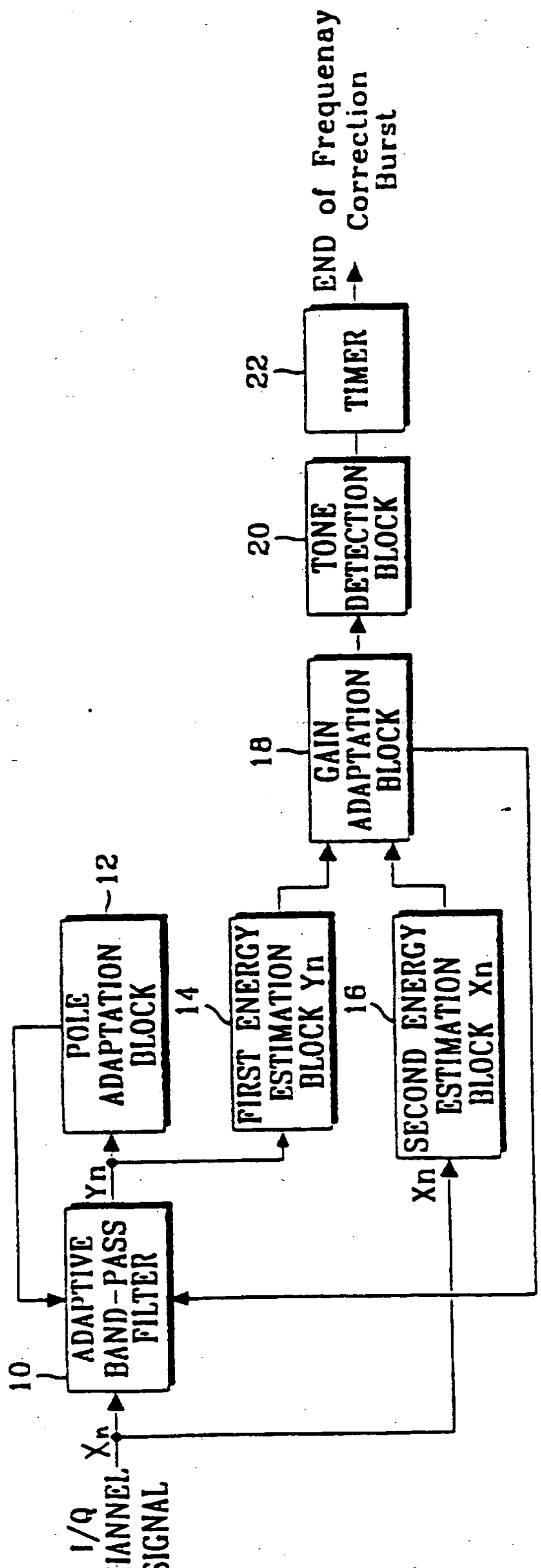

I/Q CHANNEL SIGNAL
Xn
10
ADAPTIVE BAND-PASS FILTER
Yn
12
POLE ADAPTATION BLOCK
14
FIRST ENERGY ESTIMATION BLOCK Yn
16
SECOND ENERGY ESTIMATION BLOCK Xn
Xn
18
GAIN ADAPTATION BLOCK
20
TONE DETECTION BLOCK
22
TIMER
END of Frequenay Correction Burst

FIG. 1

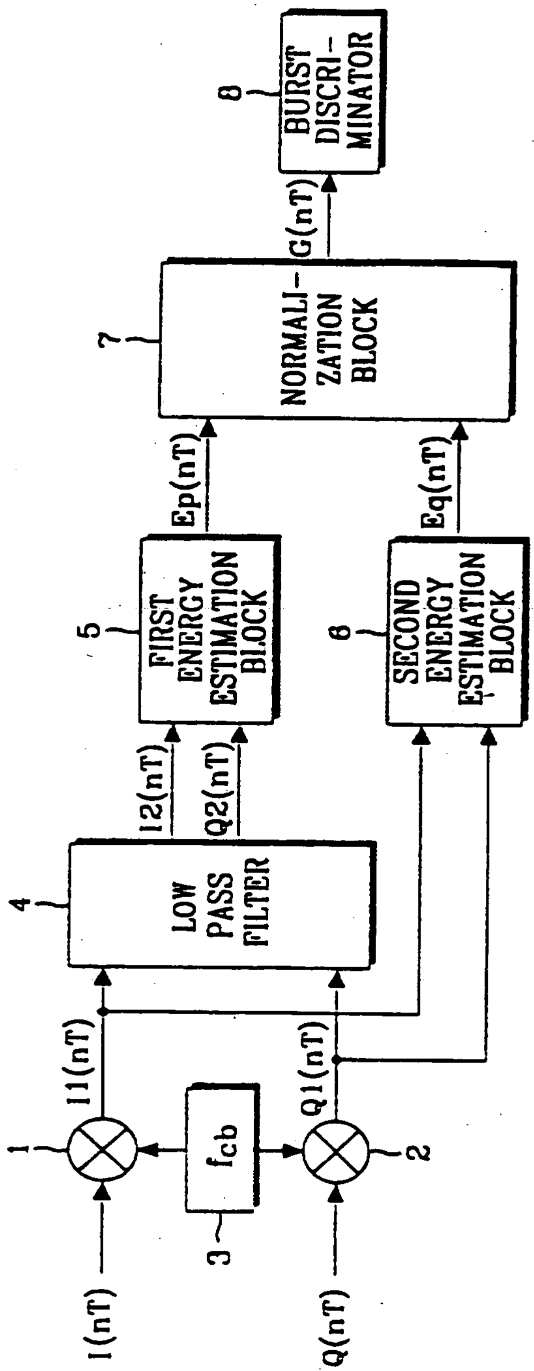

I(nT)
Q(nT)
1
2
3
f_{cb}
I1(nT)
Q1(nT)
4
LOW PASS FILTER
I2(nT)
Q2(nT)
5
FIRST ENERGY ESTIMATION BLOCK
6
SECOND ENERGY ESTIMATION BLOCK
Ep(nT)
Eq(nT)
7
NORMALI-ZATION BLOCK
G(nT)
8
BURST DISCRI-MINATOR

FIG. 2

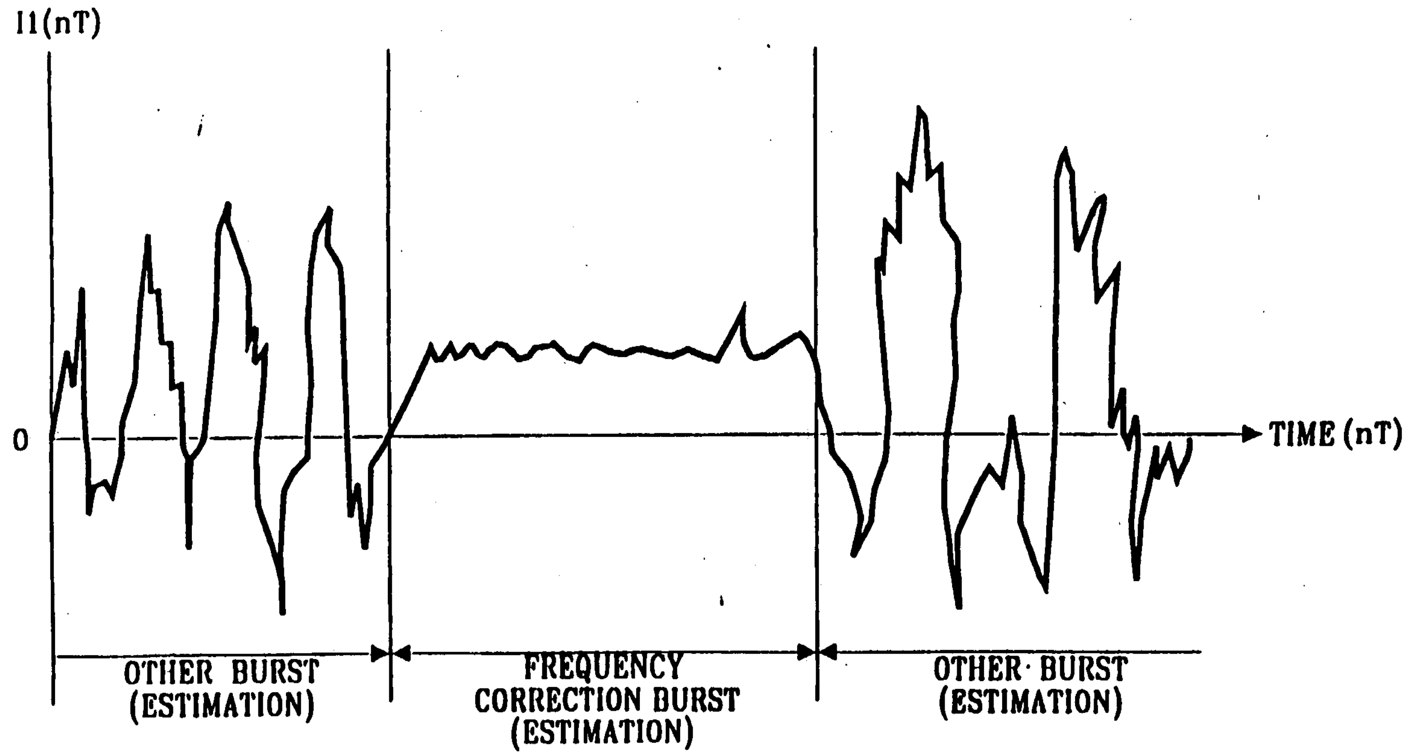

I1(nT)
0
TIME (nT)
OTHER BURST
(ESTIMATION)
FREQUENCY
CORRECTION BURST
(ESTIMATION)
OTHER BURST
(ESTIMATION)

FIG. 3A

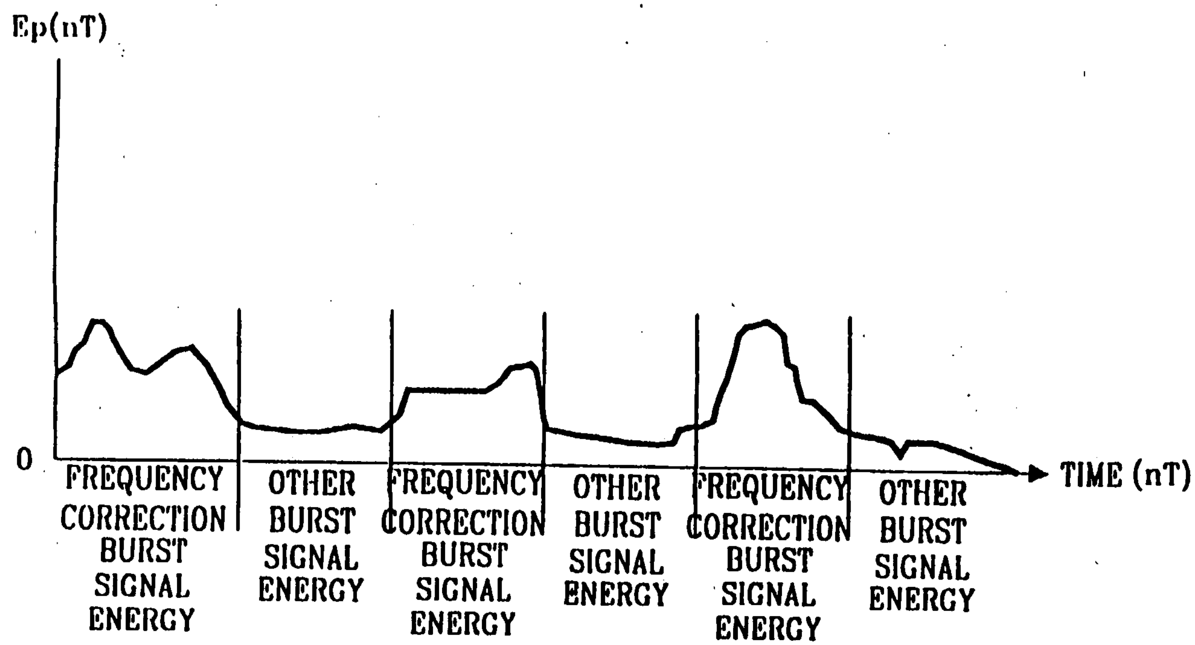

Ep(nT)
0
TIME (nT)
FREQUENCY CORRECTION BURST SIGNAL ENERGY
OTHER BURST SIGNAL ENERGY
FREQUENCY CORRECTION BURST SIGNAL ENERGY
OTHER BURST SIGNAL ENERGY
FREQUENCY CORRECTION BURST SIGNAL ENERGY
OTHER BURST SIGNAL ENERGY

FIG. 3B

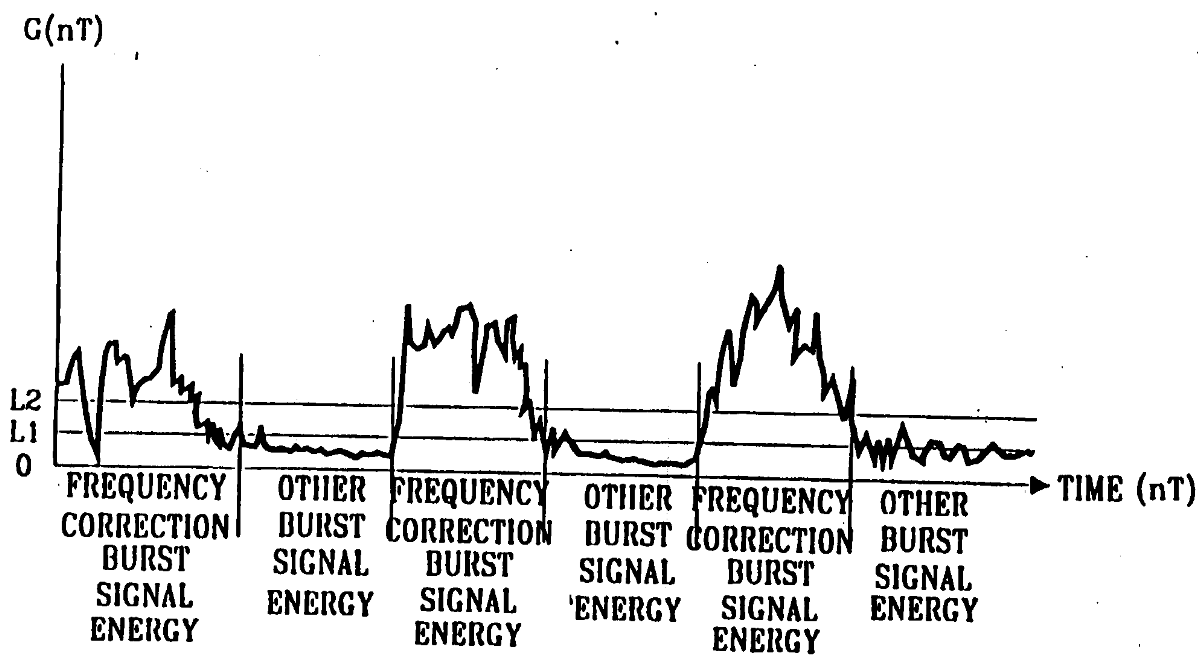
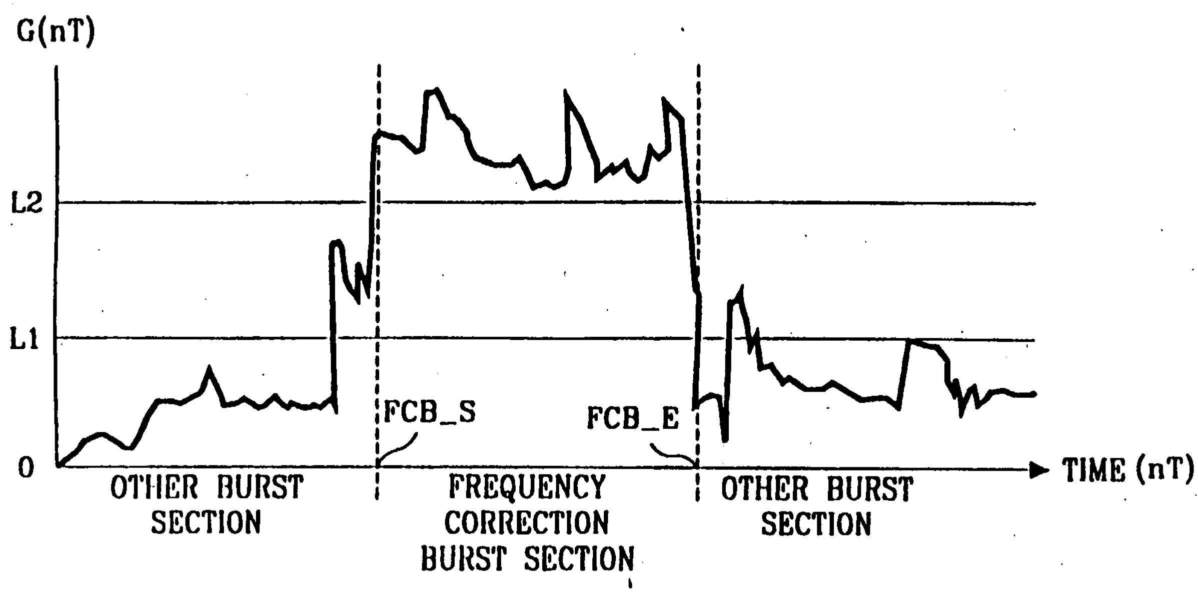

G(nT)
L2
L1
0
TIME (nT)
FREQUENCY CORRECTION BURST SIGNAL ENERGY
OTHER BURST SIGNAL ENERGY
FREQUENCY CORRECTION BURST SIGNAL ENERGY
OTHER BURST SIGNAL ENERGY
FREQUENCY CORRECTION BURST SIGNAL ENERGY
OTHER BURST SIGNAL ENERGY

FIG. 3C



G(nT)
L2
L1
0
FCB_S
FCB_E
TIME (nT)
OTHER BURST SECTION
FREQUENCY CORRECTION BURST SECTION
OTHER BURST SECTION

FIG. 3D

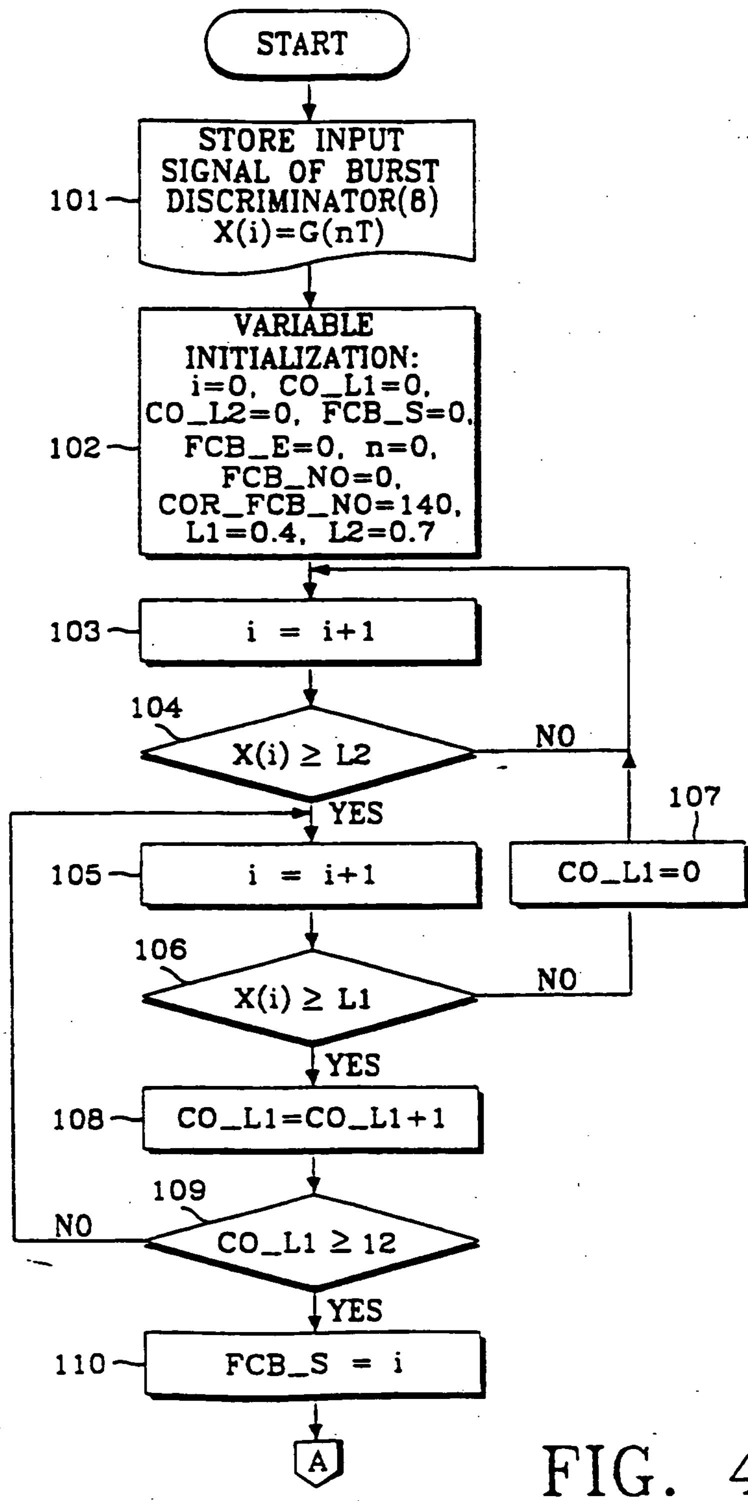

START
STORE INPUT SIGNAL OF BURST DISCRIMINATOR(8) X(i)=G(nT)
101
VARIABLE INITIALIZATION: i=0, CO_L1=0, CO_L2=0, FCB_S=0, FCB_E=0, n=0, FCB_NO=0, COR_FCB_NO=140, L1=0.4, L2=0.7
102
i = i+1
103
104
X(i) ≥ L2
NO
YES
107
CO_L1=0
i = i+1
105
106
X(i) ≥ L1
NO
YES
CO_L1=CO_L1+1
108
109
CO_L1 ≥ 12
NO
YES
FCB_S = i
110
A

FIG. 4A

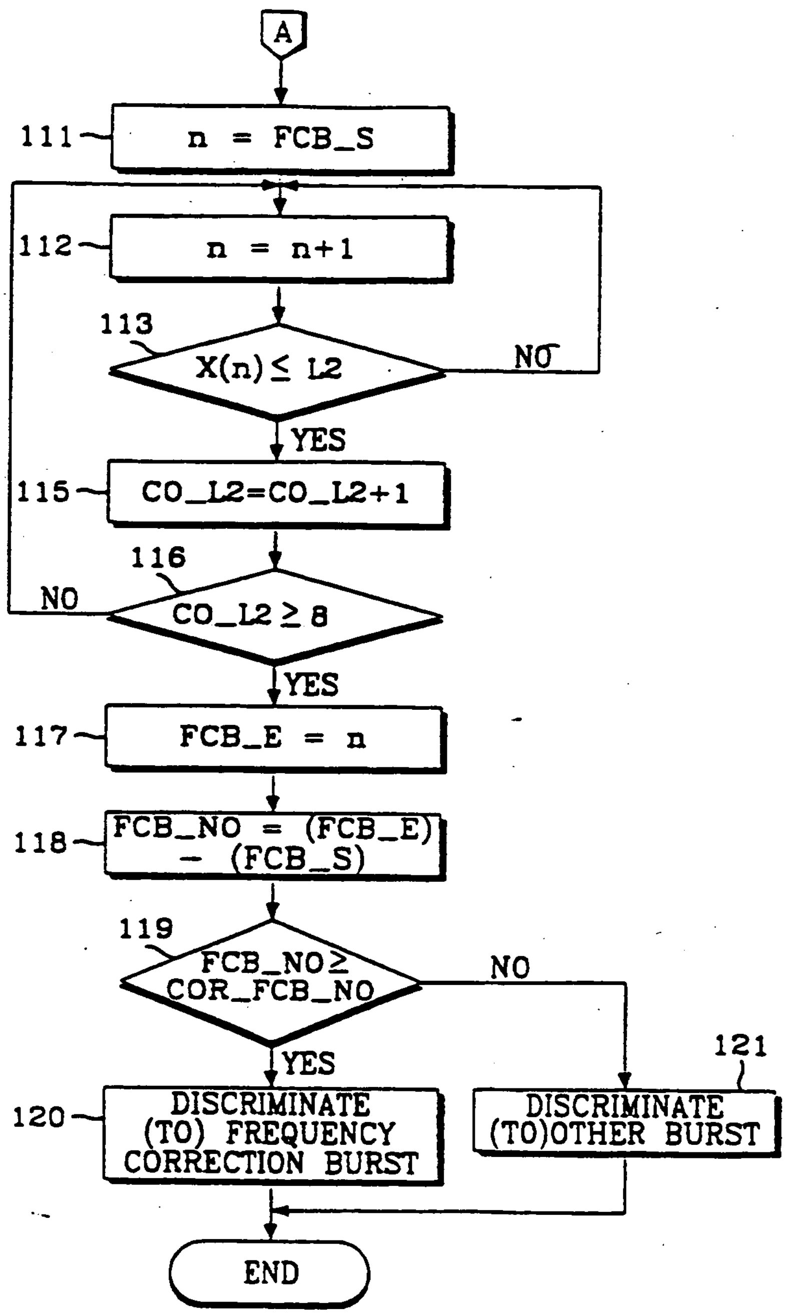

A
111
n = FCB_S
112
n = n+1
113
X(n) ≤ L2
NO
YES
115
CO_L2=CO_L2+1
116
NO
CO_L2 ≥ 8
YES
117
FCB_E = n
118
FCB_NO = (FCB_E) − (FCB_S)
119
FCB_NO ≥ COR_FCB_NO
NO
YES
120
DISCRIMINATE (TO) FREQUENCY CORRECTION BURST
121
DISCRIMINATE (TO)OTHER BURST
END

FIG. 4B

2316840

CIRCUIT AND METHOD FOR DETECTING FREQUENCY CORRECTION BURST IN TDMA DIGITAL MOBILE COMMUNICATION SYSTEM

Background of the Invention

1. Field of the Invention

The present invention relates to a circuit and a method for detecting a frequency correction burst in a time division multiple access (TDMA) digital mobile communication system, more particularly, to a circuit and a method for in a mobile station detecting a frequency correction burst, which is periodically transmitted from a base station to achieve a frequency synchronization between the base station and the mobile station in the TDMA digital mobile communication system.

2. Description of the Related Art

Generally, in order to transmit and receive data between the base station and the mobile station in the digital mobile communication system, a frequency correction burst signal, in the form of 148 bits of binary data 0, is transmitted using GMSK from the base station to the mobile station. At this time, in the mobile station, the frequency correction burst signal is detected and a frequency offset is estimated so as to adjust the frequency synchronization with the base station. A method for detecting the frequency correction burst signal to adjust the frequency synchronization between the base station and the mobile station, is disclosed in U.S. Patent No. 5,241,688, which is shown in Fig. 1.

Fig. 1 is a circuit diagram illustrating a prior art circuit for detecting a frequency correction burst. Referring to Fig. 1, an adaptive band-pass filter 10 filters one signal of an I and Q channel signal modulated

by continuous phase shift keying of a baseband signal and outputs the band-filtered signal to a pole adaptation block 12 and a first energy estimation block 14. The signal output from the filter is labelled Yn. The filtered signal is given in equation (1). Both the gain and the pole of this filter are adaptive. The pole of the filter is moved to so that the pass-band of the filter encompass the received signal. An instantaneous frequency of the band-filtered signal is estimated in the energy estimation block 14, and then is fed back to the adaptive band-pass filter 10.

$$y_{n+1} = b_n x_{n+1} + a_n y_n + (-ro^2)\, y_{n-1} \ldots\ldots\ldots\ldots (1)$$

The energy estimation block 14 estimates the energy of the signal y_n band-filtered from the adaptive band-pass filter 10 using equation 2, and outputs the energy to a gain adaptation block 18.

$$E(y)_{n+1} = (1-a_e)Ey_n + a_e y_n^2 + 1 \qquad \ldots\ldots\ldots\ldots (2)$$

A second energy estimation block 16 estimates the energy of an input signal x_n using equation 3.

$$E(x)_{n+1} = (1-a_e)E(x)_n + a_e x_{n+1}^2 \qquad \ldots\ldots\ldots\ldots (3)$$

The gain adaptation block 18 compares the energy $E(x)_{n+1}$ estimated from the second energy estimation block 16 with the energy $E(y)_{n+1}$ estimated from the first energy estimation block 14 so as to adapt the gain of the adaptive band-pass filter. The gain adaptation block 18 outputs the adapted gain to a tone detection block 20. The adapted gain signal is fed back to the adaptive band-pass filter 10 to control the gain value of the filter. The tone detection block 20 checks whether or not a tone signal has been detected from the adapted gain signal. At this time, when the tone signal is detected from the tone detection

block 20, a timer 22 detects a frequency correction burst completion time index, thereby completing the frequency correction burst.

The method for detecting the frequency burst mentioned in the above, uses a complicated adaptive band-pass filter in order to detect the frequency correction burst, even in circumstances in which the mobile communication channel has a multiple path fading characteristic. Since the pole adaption block 12 and the gain adaption block 18 are additionally required to adapt the pole position and the gain of the adaptive band-pass filter 10, the hardware becomes complicated and a large amount of calculation to process the digital signal is required. Also, since the frequency tolerance of the local oscillator used in a radio frequency (RF) receiver and a doppler shift frequency generated by the speed of the mobile station are not taken into account, the frequency correction burst may not be detected or a significant period of time is required to detect the frequency correction burst.

It is an object of the present invention to at least mitigate some of the problems of the prior art.

Accordingly, a first aspect of the present invention provides a circuit for detecting frequency correction burst, comprising :

a first multiplication block for receiving as an input I-channel data modulated using continuous phase shift keying and multiplying said input I-channel data by a sine wave signal having a frequency given by the frequency correction burst and producing a first channel signal I1(nT);

a second multiplication block for receiving as an input Q-channel data modulated using continuous phase shift keying, multiplying said input Q-channel data by the sine wave signal frequency given by the frequency correction burst and producing a second channel signal Q1(nT);

a lowpass filter for lowpass-filtering the first and second channel signals I1(nT) and Q1(nT), and producing channel signals I2(nT) and Q2(nT);

a first energy estimation block for estimating energies of said channel signals I2(nT) and Q2(nT) multiplied by the said wave frequency of said frequency correction burst and producing first instantaneous signal energy E_p(nT);

a second energy estimation block for estimating energies of said first and second channel signals I1(nT) and Q1(nT) multiplied by said sine wave frequency of said frequency correction burst, and producing a second instantaneous signal energy E_q(nT);

a normalization block for normalizing said first instantaneous signal energy E_p(nT) output from said first energy estimation block to said second instantaneous signal energy E_q(nT) and producing a normalised signal G(nT); and

a burst discriminator for detecting the frequency correction burst from said normalized signal G(nT).

Advantageously, present invention provide a circuit and a method for detecting a frequency correction burst in a time division multiple access (TDMA) digital mobile communication system, whereby the hardware is simplified even for a channel having a multiple path fading characteristic.

Still further, the present invention provides a circuit and a method for detecting a frequency correction burst, whereby the effect which a multiple path fading signal of a mobile communication and a doppler shift frequency generated by the speed of the mobile station have on an receiving signal, are minimized, so that the probability of not detecting the frequency correction burst can be reduced.

Preferably, the present invention allows for the detection of a frequency correction burst, whereby a signal

is processed in a baseband of a mobile station even taking into account the tolerance of a local oscillator used in a radio frequency receiver is incorrect. Suitably, the time required for detecting the frequency correction burst can be reduced.

Preferably, an embodiment of the present invention provides a circuit wherein said burst discriminator comprising :

means for detecting a frequency correction burst start time index from said normalized signal G(nT);

means for detecting a frequency correction burst end time index from said normalized signal G(nT);

means for subtracting said detected frequency correction burst start time index from said detected frequency correction burst end time index and producing a frequency correction burst length; and

means for comparing said produced frequency correction burst length with a base frequency correction burst length, thereby discriminating a frequency correction burst.

A second aspect of the present invention provides a method for detecting frequency correction burst, comprising the steps of:

receiving as an input I and Q channel data modulated using continuous phase shift keying and multiplying said I and Q channel data by a sine wave signal having a frequency given by a frequency correction burst and producing respectively first and second channel signals I1(nT) and Q1(nT);

lowpass-filtering said first and second channel signals I1(nT) and Q1(nT), and producing signals I2(nT) and Q2(nT);

estimating energies of said lowpass-filtered I2(nT) and Q2(nT) signals, and producing a first instantaneous signal energy $E_p(nT)$;

estimating energies of said first and second channel signals I1(nT) and Q1(nT), and producing a second

instantaneous signal energy $E_q(nT)$;

normalizing said first instantaneous signal energy $E_p(nT)$ to said second instantaneous signal energy $E_q(nT)$, and producing a normalized signal $G(nT)$; and

detecting a frequency correction burst from said normalized signal $G(nT)$.

Preferably, an embodiment provides a method wherein said step of detecting said frequency correction burst further comprising the steps of :

detecting a frequency correction burst start time index from said normalized signal $G(nT)$;

detecting a frequency correction burst end time index from said normalized signal $G(nT)$;

subtracting said detected frequency correction burst start time index from said detected frequency correction burst end time index, thereby producing a frequency correction burst length; and

comparing said produced frequency correction burst length with a base frequency correction burst length, thereby discriminating a frequency correction burst.

Brief Description of the Drawings

A preferred embodiment of the present invention will be described in detail with reference to the accompanying drawings, wherein;

Fig. 1 is a circuit diagram illustrating a prior art circuit for detecting a frequency correction burst;

Fig. 2 is a circuit diagram illustrating a circuit for detecting a frequency correction burst according to an embodiment of the present invention;

Figs. 3A to 3D are waveform diagrams illustrating operations of all components in Fig. 2 according to an embodiment of the present invention; and

Figs. 4A and 4B are flow charts illustrating control procedure for detecting a frequency correction burst according to an embodiment of the present invention.

Throughout the drawings, the same reference numerals or letters will be used to designate the same or equivalent elements having the same function.

Detailed Description of the Preferred Embodiment

Fig. 2 is a circuit diagram illustrating a circuit for detecting a frequency correction burst according to an embodiment of the present invention. A frequency generator 3 generates a sine wave signal having a frequency which is identical to the frequency correction burst. A first multiplication block 1 receives as an input I channel data modulated using continuous phase shift keying and multiplies the input I channel data by the sine wave signal of the frequency correction burst and outputs a signal I1(nT). A second multiplication block 2 receives as an input Q channel data modulated using continuous phase shift keying and multiplies the input Q channel data by the sine wave signal of the frequency correction burst and outputs a signal Q1(nT). A low pass filter 4 lowpass-filters the signals I1(nT) and Q1(nT) multiplied by the sine wave signal of the frequency correction burst and outputs signals I2(nT) and Q2(nT).

A first energy estimation block 5 estimates energies of the signals I2(nT) and Q2(nT) output from the low pass filter 4 to produce an instantaneous signal energy $E_p(nT)$. A second energy estimation block 6 estimates energies of the signals I1(nT) and Q1(nT) multiplied by the sine wave signal of the frequency correction burst to produce an instantaneous signal energy $E_q(nT)$. A normalization block 7 normalizes the instantaneous signal energy $E_p(nT)$ output from the first energy estimation block 5 to the instantaneous signal energy $E_q(nT)$ output from the second energy estimation block 6 to thereby produce a normalized signal G(nT). A burst discriminator 8 detects the frequency correction burst from the signal G(nT) normalized

by the normalization block 7.

Figs. 3A to 3D are waveform diagrams illustrating the signals produced by the operation of all components in Fig. 2 according to an embodiment of the present invention.

Figs. 4A and 4B are flow chart illustrating a control procedure for detecting a frequency correction burst according to an embodiment of the present invention.

Referring to Figs. 2 to 4A and 4B, the operation according to the preferred embodiment of the present invention will be explained hereinafter.

The input signals I(nT) and Q(nT) are baseband digital signals modulated using continuous phase shift keying received through the antenna of the mobile station, a duplexer, the RF receiver and an analog to digital (A/D) converter. The signals may correspond to signal of the frequency correction burst periodically transmitted from the base station for the frequency synchronization between base station and the mobile station and of the other bursts. The signals include the multiple path fading of the mobile communication channel and an additive white gaussain noise. The frequency generator 3 generates a sine wave signal of frequency f_{cb} determined by the frequency correction burst. The first multiplication block 1 receives as an input the I channel data modulated using continuous phase shift keying and multiplies the input I channel data by the sine wave signal and outputs the signal I1(nT) having the frequency correction burst signal and the other burst signals as shown in Fig. 3A. The second multiplication block 2 receives as an input the Q channel data modulated using continuous phase shift keying and multiplies the input Q channel data by the sine wave frequency of the frequency correction burst and outputs the signal Q1(nT). Since the Q channel signal is similar to the I channel signal except for the phase difference of 90

degrees, the Q channel signal is not shown. The signal I1(nT) corresponding to the frequency correction burst in Fig. 3A, comprises a direct current (DC) component affected by the frequency tolerance of the local oscillator used in RF receiver, the doppler shift frequency generated by the speed of the mobile station and the additive white gaussain noise. However, the other burst signals except for the frequency correction burst almost show a wave form indicative of optional periodic characteristic. The low pass filter 4 lowpass-filters the signals I1(nT) and Q1(nT) multiplied by the sine wave signal of the frequency correction burst, to produce output signals I2(nT) and Q2(nT). At this time, a cutoff frequency f_{cut} of the low pass filter 4 is calculated by following equation 4.

$$f_{cut}=(r)f_{LO}+f_D \quad \ldots\ldots\ldots\ldots(4)$$

Here, r is an tolerance of the local oscillator frequency of the RF receiver, f_{LO} is an local oscillator frequency and f_D is a doppler shift-frequency. The low pass filter removes those frequency components which are attributable to the doppler frequency and the tolerance of the local oscillator. The first energy estimation block 5 estimates the energies of the signals I2(nT) and Q2(nT) output from the low pass filter 4 and outputs the instantaneous signal energy $E_p(nT)$ as shown in Fig. 3B. The instantaneous signal energy $E_p(nT)$ is calculated by following equation 5.

$$E_p(nT)=[I2(nT)]^2+[Q2(nT)]^2 \quad \ldots\ldots\ldots(5)$$

The second energy estimation block 6 estimates the energies of the signals I1(nT) and Q1(nT) multiplied by the sine wave signal of the frequency correction burst, thereby outputting the instantaneous signal energy $E_q(nT)$. At this time, it is difficult to discriminate the frequency correction burst from the other bursts by estimating the signal $E_p(nT)$ due to the multiple path fading characteristic

of the mobile station as shown in Fig. 3B. So, in order to detect only the frequency correction burst, the normalization block 7 normalizes the instantaneous signal energy $E_p(nT)$ output from the first energy estimation 5 to the instantaneous signal energy $E_q(nT)$ output from the second energy estimation block 6, thereby outputting the signal G(nT) as shown in Fig. 3C to the burst discriminator 8. The wave form shown in Fig. 3D illustrates, in greater detail, the normalized output signal G(nT). The burst discriminator 8 detects the frequency correction burst from the signal G(nT) normalized by the normalization block 7. The normalization process calculates $G(nT) = E_p(nT)/E_q(nT)$.

Referring to Fig. 4, the operation of the burst discriminator 8 for detecting the frequency correction burst from the normalized signal G(nT) will now be explained. In step 101, the normalized signal G(nT) received from the normalization block 7 is stored and the stored signal is denoted X(i). Here, i is larger than 150. When the storage of the normalized signal is performed, in step 102, all variables are initialized such as i=0, CO_L1=0, CO_L2=0, FCB_S=0, FCB_E=0, n=0, FCB_NO=0, COR_FCB_NO=140, L1=0.4 and L2=0.7. Here, FCB_S is a time index discriminated by a frequency correction burst start, FCB_E is a time index discriminated by a frequency correction burst end, and FCB_NO calculated by (FCB_E)-(FCB_S) denotes a frequency correction burst length. COR_FCB_NO is a burst length base value for discriminating the frequency correction burst, and L1 and L2 are base values of the signal energy G(nT) for discriminating the frequency correction burst start/end time indexes and are such that L1>L2. CO_L1 is a variable for discriminating the frequency correction burst start time index, and CO_L2 is a variable for discriminating the frequency correction burst end time index. The variable n is used to store FCB_S and FCB_E. In step 103, the index i of storing the normalized signal is increased by 1. In the step 104, it is checked whether X(i) is greater than or equal to L2. If

it is determined that X(i) is less than L2, i is continually increased until X(i) is greater than or equal to L2. In the step 105, the index i for accessing the normalized signal is again increased by 1. Then, in step 106, it is checked whether X(i) is greater than or equal to L1. If it is determined that X(i) is less than L1, processing proceeding to step 107. In the step 107, the variable CO_L1 for discriminating the frequency correction burst start time index, is initialized to zero, and processing returns to step 103. However, if it is determined that X(i) is greater than or equal to L1, step 108 is performed. In the step 108, the variable CO_L1 for discriminating the frequency correction burst start time index, is increased by 1. Then, in step 109, it is checked whether the variable CO_L1 is greater than or equal to 12. If it is determined that the variable CO_L1 for discriminating the frequency correction burst start time index, is less than 12, processing returns to step 105 and the foregoing operation is repeated. However, if it is determined that the variable CO_L1 is greater than or equal to L2, step 110 is performed. In step 110, the time index FCB_S discriminated by the frequency correction burst start is set to i. The time index FCB_S is stored within variable n in step 111 and n is increased by 1 in step 112. Then, in step 113, it is checked whether X(n) is less than or equal to L2. If it is determined that X(n) is greater than L2, processing returns to step 112. However, in the step 113, if X(n) is less than or equal to L2, the variable CO_L2 for discriminating the frequency correction burst end time index, is increased by 1 in step 115. In the step 116, it is checked whether the variable CO_L2 for discriminating the frequency correction burst end time index, is greater than or equal to 8. If CO_L2 is less than 8, processing returns to step 112. However, if CO-L2 is greater than or equal to 8, the time index FCB_E discriminated by the frequency correction burst end, is set to n in step 117. Then in step 118, the frequency correction burst length FCB_NO is calculated by FCB_E -

FCB_S. In step 119, it is determined whether the frequency correction burst length FCB_NO is greater than or equal to the burst length base value COR_FCB_NO for discriminating the frequency correction burst. If FCB_NO is less than the value COR_FCB_NO, the other burst is detected in step 121. However, if FCB_NO is greater than or equal to the value COR_FCB_NO, the frequency correction burst signal is detected in step 120.

The present invention has advantages in which the signal energy of the frequency correction burst is definitely discriminated from the signal energy of the other burst and is detected even in the multiple path fading environment of the mobile communication channel, and the frequency tolerance of the local oscillator used in the RF receiver and the doppler shift frequency generated by the speed of the mobile station are considered so that the out of band noise having an effect on the frequency correction burst can be minimized.

While there have been illustrated and described what are considered to be preferred embodiments of the present invention, it will be understood by those skilled in the art that various changes and modifications may be made, and equivalents may be substituted for elements thereof without departing the true scope of the present invention.

CLAIMS

1. A circuit for detecting frequency correction burst, comprising :

a first multiplication block for receiving as an input I-channel data modulated using continuous phase shift keying and multiplying said input I-channel data by a sine wave signal having a frequency given by the frequency correction burst and producing a first channel signal I1(nT);

a second multiplication block for receiving as an input Q-channel data modulated using continuous phase shift keying, multiplying said input Q-channel data by the sine wave signal frequency given by the frequency correction burst and producing a second channel signal Q1(nT);

a lowpass filter for lowpass-filtering the first and second channel signals I1(nT) and Q1(nT), and producing channel signals I2(nT) and Q2(nT);

a first energy estimation block for estimating energies of said channel signals I2(nT) and Q2(nT) multiplied by the said wave frequency of said frequency correction burst and producing first instantaneous signal energy $E_p(nT)$;

a second energy estimation block for estimating energies of said first and second channel signals I1(nT) and Q1(nT) multiplied by said sine wave frequency of said frequency correction burst, and producing a second instantaneous signal energy $E_q(nT)$;

a normalization block for normalizing said first instantaneous signal energy $E_p(nT)$ output from said first energy estimation block to said second instantaneous signal energy $E_q(nT)$ and producing a normalised signal G(nT); and

a burst discriminator for detecting the frequency correction burst from said normalized signal G(nT).

2. The circuit as claimed in Claim 1, said burst discriminator comprising :

means for detecting a frequency correction burst start

time index from said normalized signal G(nT);

means for detecting a frequency correction burst end time index from said normalized signal G(nT);

means for subtracting said detected frequency correction burst start time index from said detected frequency correction burst end time index and producing a frequency correction burst length; and

means for comparing said produced frequency correction burst length with a base frequency correction burst length, thereby discriminating a frequency correction burst.

3. The method as claimed in Claim 6, said step of discriminating said frequency correction burst further comprising a step of :

discriminating said frequency correction burst when said produced frequency correction burst length is larger than said base frequency correction burst length.

4. The method as claimed in Claim 6, said step of discriminating said frequency correction burst further comprising a step of:

discriminating other burst when said produced frequency correction burst length is less than said base frequency correction burst length.

5. A method for detecting frequency correction burst, comprising the steps of:

receiving as an input I and Q channel data modulated using continuous phase shift keying and multiplying said I and Q channel data by a sine wave signal having a frequency given by a frequency correction burst and producing respectively first and second channel signals I1(nT) and Q1(nT);

lowpass-filtering said first and second channel signals I1(nT) and Q1(nT), and producing signals I2(nT) and Q2(nT);

estimating energies of said lowpass-filtered I2(nT) and Q2(nT) signals, and producing a first instantaneous

signal energy $E_p(nT)$;

estimating energies of said first and second channel signals $I1(nT)$ and $Q1(nT)$, and producing a second instantaneous signal energy $E_q(nT)$;

normalizing said first instantaneous signal energy $E_p(nT)$ to said second instantaneous signal energy $E_q(nT)$, and producing a normalized signal $G(nT)$; and

detecting a frequency correction burst from said normalized signal $G(nT)$.

6. The method as claimed in Claim 5, said step of detecting said frequency correction burst further comprising the steps of :

detecting a frequency correction burst start time index from said normalized signal $G(nT)$;

detecting a frequency correction burst end time index from said normalized signal $G(nT)$;

subtracting said detected frequency correction burst start time index from said detected frequency correction burst end time index, thereby producing a frequency correction burst length; and

comparing said produced frequency correction burst length with a base frequency correction burst length, thereby discriminating a frequency correction burst.

7. The method as claimed in Claim 6, said step of discriminating said frequency correction burst further comprising a step of :

discriminating said frequency correction burst when said produced frequency correction burst length is larger than said base frequency correction burst length.

8. The method as claimed in Claim 6, said step of discriminating said frequency correction burst further comprising a step of:

discriminating other burst when said produced frequency correction burst length is less than said base frequency correction burst length.

9. A circuit for detecting frequency correction burst substantially as described herein with reference to and/or as illustrated in figures 2 to 4.

10. A method for detecting frequency correction burst substantially as described herein with reference to and.or as illustrated in figures 2 to 4.

The Patent Office

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Claims searched:	1-10	**Date of search:**	5 November 1997

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Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): H4L (LDC,LDLX), H4P (PAQ)

Int Cl (Ed.6): H04B 7/22, 7/26

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	US5241688 (Motorola)	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.